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(54) Lighting Fixture with Continuously Adjustable Modification of the Color and the Light Cone

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Title: **Lighting Fixture with Continuously Adjustable Modification of the Color and the Light Cone**

The invention relates to lighting fixtures with continuously adjustable modification of the color of the light, and electric-motor-driven adjustment of the light cone, which fixtures are used to illuminate paintings or residential rooms or workplaces.

Lighting fixtures are known in the form of lamps, luminaires, flood lights, and many others. Their function is to brighten and provide the proper lighting for dark rooms and objects. Based on the use of precise photometric means, it is now possible to provide good full illumination for rooms and objects.

Today, lighting technology makes available an extremely wide selection of light sources such as incandescent bulbs, fluorescent tubes, gas discharge lamps, LEDs, and many others. The appropriate light source is selected and employed depending on the application.

So-called warm light and cool light are often mentioned. The so-called warm light of an incandescent bulb has a larger yellow-red component than does the cool light of fluorescent tubes.

The sensitivity of the human eye varies considerably from person to person, and as a result, the subjective impression of the light is ultimately judged to be either good or less than good. Precise colorimetric measurements are generally not performed in

response to lighting problems. Once in place, the light source used is as good as it is going to be for the illuminated room or object, and there is no ability to make any color correction for light of a given brightness.

Additional disadvantages result from the fact that the color of the light cannot be modified. The light emitted is reflected from the illuminated room or objects as a different, often undesirable, color.

The color changes addressed here are nuanced changes (red, yellow, orange, green, and/or blue) – not the sharp color changes generated using auxiliary filters on the light sources, or by lasers in discotheques.

The lamps currently available on the market in which the color of the light is modified achieve this primarily by dimming the light sources, that is, supplying them with reduced power. The light then changes its color from white to yellow and red tones. The disadvantage is that the light becomes dimmer. The color can only be changed to yellow and red tones.

The market also offers light sources in which modification of color is achieved by changing the wavelength. These high-pressure gas discharge lamps are constructively very large and also expensive, and as a result, do not find application in the domestic sphere. The color scale here is also quite restricted.

It has been proposed that a plurality, for example 50, LEDs of high luminance be arranged in an adjacent configuration and utilized as a working lamp.

The majority of the LEDs emit white light, while a few individual LEDs emit yellow, red, green, or blue light. When the color LEDs are combined with the white light, colored light is produced.

The disadvantage of this proposal is easily recognized. First, LEDs are not able to achieve the desired brightness of a spotlight of, for example, 40 watts. Second, a plurality of LEDs is arranged on a surface in order to obtain a light at least approximating a 25 watt lamp. Since the LEDs are arranged over a relatively large surface, and the individual color LEDs also emit from this surface, the light produced does not have a homogeneous hue. In addition, it is impossible to accommodate a curved reflector in a small space.

The proposal to employ LEDs with inbuilt color changing capability has the great disadvantage that only a color change from white to a yellow-red hue is possible, not the entire color scale, and, as was mentioned above, brightness is extremely limited.

In summary, the conclusion may be drawn that use of prior art technology does not provide any possibility of using a lighting fixture to mix continuously and homogeneously the color of the white light with the colors red, orange, yellow, green, or blue – and their secondary colors – in response to any given power input, and at a cost appropriate for domestic use and of a constructive design which is insignificantly larger than current designs.

The goal of the invention is a lighting fixture with continuously adjustable and homogeneous modification of the light color of white light at a high power input, for

example, 100 watts (and thus high brightness of the white light source), and with electric-motor-driven adjustment of the light cone.

This goal is achieved according to the invention using the referenced lighting fixture by introducing colored light into the reflector from the lower edge of the reflector, then, after reflection of this colored light beam within the reflector, homogeneously mixing this light with the white light and emitting it from the front of the reflector as colored light (slightly tinted).

In order to fit its small size, LEDs of small diameter are employed to generate the colored light beam.

The light fixture according to the invention has a number of advantages.

Due to the introduction of the colored light from the lower edge of the reflector, the colored light beam undergoes multiple reflections so as to converge toward the center of the reflector, then emerge at the front as homogeneously mixed colored light in the normal beam direction of the reflected light beam from the reflector. The LEDs which emit the colored light are continuously controlled in terms of brightness by a potentiometer.

An odd number, such as three, of LEDs per color (for example, red, orange, yellow, green, and blue) are advantageously arranged adjacent to the lower edge of the reflector, and the colored light of the LEDs is introduced directly, or via mirrors or light guides, into the reflector where it mixes with the white light. Alternatively, depending on the design of the reflector, the colored light sources may be mounted directly in the reflector.

The colored light sources may advantageously be adjusted in terms of brightness continuously, and also electronically mixed to create any number of hues using an IC.

In addition, the invention allows for adjusting the light source of the white light to the reflector by an electric-motor drive, and thus for enlarging or reducing the angle of the light cone of the spotlight.

Using this lighting fixture, the base color of the white light may be homogeneously mixed with any number of hues by remote control, and at greater or lesser intensities, and the light cone adapted to given requirements by remote control from an appropriate wall switch.

The constructive size will advantageously not exceed, or will exceed only insignificantly, that of commercially available spotlights. The price of such a lighting fixture will also be only slightly higher for the end user than that of a white-light spotlight.

Using this invention, both the color of the light as well as the light cone may be continuously adjusted from a suitable rotary pressure switch (mounted on the wall).

Use of this lighting fixture according to the invention now allows for adjustment of the light in terms of color, not only for a painting but also for rooms or for the workplace according to special requirements, as well as adjustment of the angle of the light cone.

The following discussion explains the invention in more detail based on the attached drawings.

Figure 1 is a section through a lighting fixture according to the invention, with the light introduced laterally.

Figure 2 is a top view of the lighting fixture according to the invention.

Figure 3 is a cross-section of another arrangement according to the invention with the light introduced by reflection, in which arrangement it is also possible for the LED support also to be in the form of a light guide.

Figure 4 is a cross-section of another example in which the colored light is introduced directly into the reflector.

Figure 5 is a cross-section of the lighting fixture according to the invention showing the modification of color by the introduction of light, and the modification of the light cone by an electric motor.

Figure 6 is a cross-section of a lighting fixture according to the invention in which the colored light is introduced by reflection via a light guide into the reflector.

Figure 7 shows the lighting fixture according to the invention installed in a room, along with the associated wall switch.

Figure 1 shows a lamp holder 1 with associated connecting wires 2 and an incandescent bulb 3 (white light, for example 100 watt) along with the reflector 4. According to the invention, a holder 5 for the LEDs 6 is located at the lower edge of the reflector, which LEDs, according to the invention direct the light beam S through openings 8 obliquely upward into the bottom region of reflector 4. The LEDs here are soldered on to

a ring-shaped circuit board 7 by soldering eyelets 9. Light beam S is reflected multiple times as indicated by the broken line within reflector 4 – which process, after the mixing with white light, produces a homogeneously tinted light emitted from the reflector.

Figure 2 is a top view of the lighting fixture according to the invention. Viewed from the top, lamp holder 1 and the associated connection wires 2 as well as reflector 4 are seen. According to the invention, an odd number of LEDs 6 of each color are provided, here three items per color, thus allowing them always advantageously to shine into the free space in reflector 4. The LEDs are soldered on to circuit board 7 by soldering connections 9. Connecting leads 28 of circuit board 7 are provided to connect to the switch and power supply. In this example, the colors red, orange, yellow, green, and blue are arranged with 24° of separation.

Figure 3 shows another possible arrangement for the LEDs. The LEDs are located in holder 11, and their colored light is directed by reflecting surface 10 in the direction of the beam through the provided passage 8 obliquely upward into reflector 4.

Figure 4 is another embodiment. Here small conduits 12 are provided to accommodate LEDs 6 and are incorporated directly in the reflector, while lamp holder 1 along with connectors 2, white-light bulb 3, and reflector 4 represent the original lamp.

Figure 5 shows how, in addition to the introduction of colored light according to the invention, reflector 4 is moved by an electric motor 21 relative to incandescent



bulb 3. This action not only allows the color of the light to be modified but also the light cone of the lighting fixture. The LEDs located in support 12 direct their colored light through openings 8 obliquely upward into the reflector, undergo multiple reflections (see Figure 1), the light then mixing with the white light to form a homogeneously mixed colored light. The variable series resistor 20 enables the brightness of the introduced colored light to be continuously modified. Lamp holder 18 is fixed, along with its connecting wires 2, to the wall or housing, as is motor 21. When the cam 22 of motor 21 is moved, the wing 23 which is permanently attached to conduit 19 is continuously moved upward or downward. This action changes the position of incandescent bulb 3 relative to the focus of reflector 4, thereby modifying the light cone of the lamp. The motor is supplied by connection leads 24 when the pressure switch 21 is actuated.

Figure 6 shows conventional reflector 4 with the white light of incandescent bulb 3 and socket 1 for the bulb, along with its connectors 2. A LED 6 located in a light guide 25 is shown at the lower edge. In this design, only one LED per color is advantageously required since the colored light of the LED is routed into the ring-shaped section of the light guide around the reflector, is reflected by mirror surface 26 in the direction of surface 27, and is there directed in the form of a color beam into the reflector as light beam S.

Figure 7 shows the rotary pressure switch 13 in the form of a wall-mounted switch. The scale 15 on switch 13 indicates the color which may be selected when the arrow 16 is superimposed on it. In addition to the colors red, orange, yellow, green, and blue, mixed colors may be selected which are produced electronically by an IC.

Light fixture 17 modifies its light cone from an angle  $\alpha$  to a desired angle  $\beta$  using an electric-motor drive when the push button 14 on switch 13 is pressed.

## Claims

1. Lighting fixture with a white light source having continuously adjustable modification of the color of the light, characterized in that colored light is introduced, or reflected, laterally into the reflector 4, and the reflector 4 is able to be adjusted axially by an electric-motor drive relative to the incandescent bulb 3 and its holder 1.

2. Lighting fixture according to Claims 1 and 2, characterized in that the light sources for the colored light are LEDs.

3. Lighting fixture according to Claim 1, characterized in that the colored light is introduced, or introduced by reflection, from the lower edge of the reflector 4 into the reflector at a slightly upward inclination.

4. Lighting fixture according to Claims 1 through 3, characterized in that the holder for the colored light sources is also in the form of a light guide 25.

5. Lighting fixture according to Claims 1 through 4, characterized in that an odd number of LEDs, preferably, three per color, are arranged with uniform separation on the reflector.

6. Lighting fixture according to Claims 1 through 5, characterized in that the brightness of the LEDs is controlled by a potentiometer.

7. Lighting fixture according to Claims 1 through 6, characterized in that different luminosities for the individual LEDs may be achieved electronically using ICs.

8. Lighting fixture according to Claims 1 through 7, characterized in that the reflector is moved axially by an electric motor relative to the light source of the white light of the incandescent bulb 3.

Figure 2

<i>rot</i>	red
<i>orange</i>	orange
<i>gelb</i>	yellow
<i>grün</i>	green
<i>blau</i>	blue